(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 November 2003 (27.11.2003)

PCT

(10) International Publication Number
WO 03/098303 A1

(51) International Patent Classification[7]: G02B 6/42

(21) International Application Number: PCT/GB03/01958

(22) International Filing Date: 7 May 2003 (07.05.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0211518.6 20 May 2002 (20.05.2002) GB

(71) Applicant *(for AE, AG, AL, AM, AT, AU, AZ, BA, BB, BE, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CY, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, FR, GB, GD, GE, GH, GM, GR, HR, HU, ID, IE, IL, IN, IS, IT, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MC, MD, MK, MN, MW, MX, MZ, NI, NL, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW only)*: **TYCO ELECTRONICS RAYCHEM NV** [BE/BE]; Diestsesteenweg 692, B-3010 Kessel-Lo (BE).

(71) Applicant *(for MG only)*: **TYCO ELECTRONICS UK LTD** [GB/GB]; Faraday Road, Dorcan, Swindon, Wiltshire SN3 5HH (GB).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **WATTE, Jan** [BE/BE]; Molenstraat 168, B-1851 Grimbergen (BE). **BELLEKENS, Kathleen** [BE/BE]; Ellestraat 26A, B-3020 Winksele-Delle (BE). **MEURS, Paul** [BE/BE]; Vaartstraat 40, Bus 01-03, B-3000 Leuven (BE). **LEEMAN, Sam** [BE/BE]; Volmolenlaan 6/00.02, B-Leuven 3000 (BE).

(74) Agent: **JAY, Anthony, William**; Tyco Electronics UK Ltd, European Patent Department, Faraday Road, Dorcan, Swindon, Wiltshire SN3 5HH (GB).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

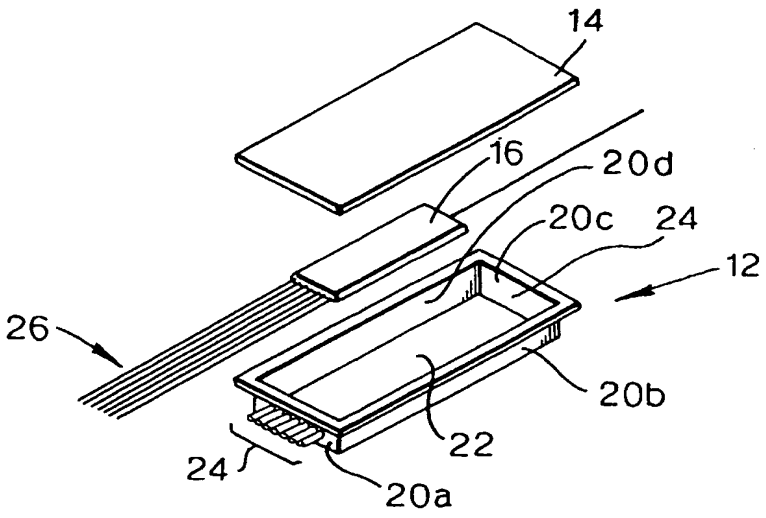
(84) Designated States *(regional)*: Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR).

Declaration under Rule 4.17:
— *of inventorship (Rule 4.17(iv)) for US only*

Published:
— *with international search report*

[Continued on next page]

(54) Title: OPTICAL FIBRE SEALING



(57) Abstract: An enclosure and method for enclosing a space into or from which at least one optical fibre is fed for optical connection of an optical component inside the enclosure to other optical components outside the enclosure. This space is enclosed by providing a substantially moisture-proof (preferably metallic) container (12) having at least one (preferably metallic) outlet sleeve (24); feeding an optical fibre (26) through the sleeve; crimping the sleeve to the optical fibre; and closing the said container with a closure member (14). Alternatively, the sleeve (24) may be placed on the optical fibre before it is positioned in an opening of the container, followed by welding of the sleeve to the container together with or separately from welding of the closure member, so as to seal the opening and enclosed space.

WO 03/098303 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

OPTICAL FIBRE SEALING

The present invention relates to optical fibre sealing. More in particular, the present invention relates to a method of and a device for sealingly enclosing a space into which one or more optical fibres are fed.

It is well known that moisture has adverse effects on the properties of optical components. The split ratio of optical splitters, for example, may be influenced by the presence of moisture, and in optical connectors moisture may lead to increased losses. The sealing of optical components against moisture and other environmental influences, in other words environmental sealing, is therefore highly desirable.

It has been proposed to environmentally seal individual optical components. This is, however, expensive and not always effective. For example it has also been proposed to seal optical fibres by metallising the outer surface of the fibres and soldering the fibres within respective apertures. However, the process steps of metallising and soldering the fibres can result in strength degradation of the fibre.

There is a requirement therefore for a method of sealing optical fibres entering an enclosed space such as the interior of an optical circuit or component enclosure which avoids at least in part the problem associated with fibre strength degradation.

According to one aspect of the invention there is a method of sealingly enclosing a space into which at least one optical fibre is fed; the method comprising the steps of:

providing a container having at least one sleeve-like tubular opening for receiving a respective optical fibre;

feeding an optical fibre through the said opening;

applying pressure to the said tubular opening to crimp the said opening to the said respective optical fibre to sealingly enclose the said optical fibre;

providing a closure member and closing the said container with the said closure member.

This method readily enables optical fibres to be sealed where they pass through openings in the

container without causing degradation to the strength of the fibre. Crimping the fibres to the tubular openings provides an effective mechanical connection between the fibre and the opening. It is preferred that the tubular openings are crimped onto the outer surface of the fibres by a mechanical die having a pair of opposing saw-tooth shaped jaws which provide a four point contact around the tubular sleeve opening such that the joint so formed is capable of withstanding at least 5N of tension in the optical fibre. By sealingly enclosing the optical fibres within respective sleeve-like tubular openings the fibres are supported over part of their length, thus preventing excessive bending of the fibres and facilitating their handling. In addition, while a good seal can be readily obtained by crimping, the fibres are not necessarily hermetically sealed, for example due to moisture leakage via the fibre coating. However, the seal is significantly easier to implement than metallising fibres and soldering them where they are fed through the aperture openings.

The method may further comprise the step of drilling the said tubular opening(s) to accommodate the respective fibre(s). In this way it is possible to accommodate different diameter fibres in the same tubular openings so that a single type of container may be used with a range of different fibre sizes.

The method may further comprise the step of proving an intermediate sleeve between the tubular opening and the respective fibres before crimping. This step may be in addition to or as an alternative to the above-mentioned step of drilling to vary the internal diameter of the tubular openings to accommodate different diameter fibres.

It is preferred that the tubular openings are positioned on and extend outward from an outer surface on the exterior of the container so that crimping is more readily enabled. This also maximises the usable volume of the enclosed space for accommodating one or more optical components or optical circuits.

It is preferred that a plurality of tubular openings are provided on the container so that a plurality of fibres can be fed into and out of the enclosed space. In this respect in-going fibres may enter the enclosed space of the container on one side thereof with outgoing fibres exiting through tubular openings on an opposite side thereof.

In preferred embodiments, at least two of the tubular opening are crimped simultaneously, preferably using a common crimping die. In this way the openings may be arranged in side-by-side relation so that opposing jaws of a crimping die engage opposing sides of the openings to be crimped in a single crimping operation.

Preferably the interior diameter of the tubular openings is in the range of 1.0 to 0.3 mm, although other diameters are also possible. The length of the tubular openings may be determined by the diameter of the fibres.

In the method of this aspect of the invention it is preferred that the container and closure member are welded together. By welding the container and closure member it is possible to reduce moisture ingress into the container between the container and closure member. It is preferred that the container and closure member are laser welded, for example using a pulse Nd:Yag laser with a pulse duration of 10 to 30 ms.

In preferred embodiments the container is a substantially rigid metal container for providing a robust enclosure for fragile optical components and/or circuits. It is preferred although not essential that the container comprises a Ni-Cu alloy material which can be easily crimped and laser welded using a Nd:Yag laser.

Preferably, the method further comprises the step of providing a humidity control means within the container. While the method of this aspect of the invention provides a good seal it may be necessary to remove moisture from the enclosed space once it has been sealed. The humidity control means may comprise a dessicant material to remove excess moisture from within the sealed container. It is envisaged that relatively small amounts of dessicant material will be required, for example compared with the sealing method described in GB patent application No. 0110366.2 since the exposed areas for moisture ingress are much smaller than the sealing type strip seal described in this earlier application.

In another aspect of the invention there is a device for sealingly enclosing a space into which at least one optical fibre is fed, produced by the above-mentioned methods of the invention. The

device may contain at least one optical component or circuit. In another aspect the present invention further provides a kit-of-parts for forming such a device.

According to another aspect of the invention there is a method of sealingly enclosing a space into which at least one optical fibre is fed; the method comprising the steps of:

providing a container and a closure member for closing the container,

providing at least one optical fibre having a metallic sleeve surrounding a selected length of the said optical fibre.

feeding the said optical fibre(s) through (a) respective opening(s) in the container and/or the closure member so as to position the said sleeve(s) in the said opening(s); and

applying the said closure member and welding the said metallic sleeve(s) into the said opening(s) so as to seal the said opening(s) and enclosed space.

In this method the metallic sleeve is first provided on the fibre so that the sleeve can be welded in a respective opening in the container and/ or closure member so that the fibre is readily secured to the container and/or closure member.

The container and closure member are then preferably welded together to provide an effective moisture resistant seal between the two components.

It is preferred that the metallic sleeve is crimped on to the outer surface of the optical fibre so that welding the sleeve to the container and/or closure member provides a relatively good mechanical connection between the fibre and the container and/or closure member while providing a relatively good moisture resistant seal.

Preferably the openings are defined between adjoining edges of the container and closure member. This readily enables the metallic sleeves, container and closure member to be welded together with the sleeves effectively sandwiched between the container and closure member at the adjoining edges thereof.

In preferred embodiments the openings are defined by respective recesses in the adjoining edges of the container and closure member which align with respect to one another to accommodate

the metallic sleeve and optic fibre. In this way it is possible to join the sleeves directly to both the container and closure member recesses.

Preferably the metallic sleeves, container and closure member are welded together by laser welding, and preferably with a respective pair of laser beams with one beam welding the metallic sleeves to the container and another beam welding the sleeves to the closure member.

In another aspect of the invention there is a device for sealingly enclosing a space into which at least one optical fibre is fed, the device being produced by the aforementioned methods of positioning the sleeves in the openings and welding the sleeves into the openings. The present invention further provides a kit-of-parts for forming this device.

According to a further aspect of the invention there is an enclosure of substantially moisture-proof material, preferably metal, sealingly enclosing at least one optical component and portions of at least one optical fibre leading from the said component through a sleeve-like member of substantially moisture-proof material, preferably metal, incorporated in the enclosure to the exterior of the enclosure for optical connection of the said component to other optical components outside the enclosure.

Preferably, the enclosure is of a shape and size for fitting into an optical fibre organiser tray.

According to another aspect of the invention there is an optical fibre organiser tray having an enclosure according to the above aspect of the invention fitted therein.

Various embodiments of the invention will now be more particularly described, by way of example, with reference to the accompanying drawings in which:

Figures 1a, 1band 1c are exploded perspective views of optical component(s) having optical fibres connected to the component(s) and an enclosure for the component(s);

Figure 2 is view similar to that of Figure 1 but suitable for optical fibres entering and exiting the enclosure on one side thereof;

Figure 3 is a perspective view of one jaw of a two jaw crimping die suitable for use in a method of the present invention;

Figure 4 is a cross-section schematic view of tubular sleeve-like members being crimped on adjacent optic fibre ends;

Figure 5 is a schematic representation of a laser welding process welding metallic sleeves surrounding selected lengths of respective optic fibres positioned in openings between an enclosure container and closure member.

Referring to Figure 1, an enclosure 10 comprises a substantially rigid metal tray type container 12 which is closed by a metal closure member 14 with an optical component 16 sealingly enclosed within the enclosed space 18 of the container. The container has a generally rectangular shape with four upstanding side walls 20a, 20b, 20c, 20d upstanding from a base portion 22. The side wall 20a is provided with a plurality of tubular sleeve-like members 24 which extend on the outward facing surface of the side wall to define a series of openings for optical fibres 26 connected to the component 16 for optical connection of the component to other optical components outside the enclosed space of the enclosure. The side wall 20c opposite the side wall 20a comprises a single opening also in the form of an aperture and tubular sleeve-like extension 24 for accommodating a single fibre 26 connected to the opposite side of the component 16 for optical connection of that component to other optical components outside the enclosure. The optical component 16 may comprise a splitter or any other passive or active component. For example, in the arrangement of Figure 1b the enclosure in configured to accommodate an array of WDM filters and includes the same number of openings 24 on both side walls 20a and 20c to accommodate the same number of incoming and outgoing fibres to the filter array. The enclosure containing the filter array and respective lengths of optic fibre connected to the filters can be mounted on a base plate 28 as shown in Figure 1c in accordance with the method described in GB patent application number 0129906.4 for fitting into an optical fibre organiser tray or in a further container closed by an organiser tray.

In the arrangement of Figure 2 the container is provided with a plurality of sleeve-like tubular openings 24 in side-by-side relation on the side wall 20a and a further single sleeve-like tubular opening on the same side wall but spaced from the other openings. The single opening accommodates a single incoming fibre connected to the optical component 16 while the other openings accommodate the outgoing fibres also connected to the optical component 16. In this arrangement the optical component is mounted directly to the base plate 28. The enclosure of

Figure 2 is of a size and shape for accommodating fibre loops within the constraints of minimum bend radius considerations.

In the arrangements of Figures 1a, 1b, 1c and 2 the lengths of fibre connected to the component 16 and passing through the openings 24 are sealingly enclosed within the sleeve-like tubular openings and mechanically joined thereto by a crimping process to be described. The fibres are first fed through respective sleeves from the interior side to the exterior of the container and when they are correctly positioned pressure is applied to the tubular openings to crimp the openings to the respective fibres to sealingly enclose the length of fibre within the opening.

Referring now to Figures 3 and 4 the step of crimping the tubular sleeves to the fibres is implemented in one embodiment using a crimping die comprising a pair of crimping jaws 30, only one of which is shown in the drawing of Figure 3, for applying pressure on both sides of the tubular sleeve being crimped. As can best be seen in the drawings of Figure 4 the jaws are provided with a respective series of V-shaped notches 32 which define a saw-tooth jaw profile such that the notches of the opposing jaws when aligned accommodate the tubular sleeves within the notches and provide a four point of contact engagement with the sleeves when the jaws are initially moved together to clamp the sleeves in the jaws. By applying pressure to the jaws the material of the sleeves surrounding the fibre deforms and crimps the sleeve to the fibre.

It is to be understood that the fibres are loosely fitted in the sleeves before crimping and typically a 0.3mm diameter sleeve 24 will be used to accommodate a 0.25 mm diameter fibre. The clearance however is not critical and other diameters can be used. The sleeves 24 may be drilled before the respective fibres are fed through so that an appropriate diameter can be formed for the fibre that is to be sealed. Additionally or alternatively a further sleeve type insert may be inserted within the bore of the sleeve between the sleeve and the fibre to effectively reduce the diameter of the bore.

In the method according to this aspect of the invention the tubular sleeve openings are preferably crimped simultaneously by the jaws of the die shown in Figures 3 and 4.

The inventors have found that the effect of the crimping process on the propagation loss

characteristics of the fibre is negligible and that a mechanical joint capable of supporting 5N of tension in the fibre is readily achievable using the above-mentioned method. The container 12 and closure 14 are preferably joined together using laser welding to form a laser weld around the adjoining edges thereof. In this respect a suitable material for the container and the closure member is KOVAR (Ni-Cu alloy) since it can be easily crimped and readily welded with Nd:Yag laser welding apparatus.

Referring now to Figure 5, in a further aspect of the invention metallic tubular sleeves are first joined to a selective length of the respective fibres 26, preferably but not necessarily by crimping. In this method the optical fibres are fed through respective openings in the form of apertures in the container and/or the closure member so that the sleeves on the fibres are positioned in the openings to enable the sleeves to be welded, by laser or other means, into the openings to seal the openings and enclosed space.

In the arrangement of Figure 5, the openings are provided by a series of spaced semi-circular cross-section recesses 36 provided in the adjoining edges of the container and closure member. When the container and closure member are correctly aligned the respective recesses 36 define circular openings in which the sleeves 24 are positioned. The container, closure member and sleeves are welded together by a pair of laser welding beams 38a, 38b which move in unison in the direction indicated by the paths 40a, 40b in the drawing.

It is to be understood that the openings in which the sleeves are positioned may be provided wholly in the container, the closure member or both, that is to say with some of the openings wholly within the container and some wholly within the closure member, or alternatively they may be provided along the adjoining edges of the container and enclosure member as shown in the drawing of Figure 5.

As described with reference to the previous method, the closure member and container are preferably welded together once the sleeves have been welded into the openings, if this does not occur simultaneously as in the embodiment of Figure 5.

Although the invention has been described with reference to the embodiments shown in the

accompanying drawings it is to be understood that the invention is not limited to those precise embodiments and that various changes and modifications may be effected without further inventive skill and effort.

5

CLAIMS

1. A method of sealingly enclosing a space into which at least one optical fibre is fed; the method comprising the steps of:

providing a container having at least one sleeve-like tubular opening for receiving a respective optical fibre;

feeding an optical fibre through the said opening;

applying pressure to the said tubular opening to crimp the said opening to the said respective optical fibre to sealingly enclose the said optical fibre;

providing a closure member and closing the said container with the said closure member.

2. A method as claimed in Claim 1 further comprising the step of drilling the said tubular opening(s) to accommodate the respective fibre(s).

3. A method as claimed in Claim 1 or Claim 2 further comprising the step of providing an intermediate sleeve between the said tubular opening(s) and the respective fibre(s) before crimping.

4. A method as claimed in any preceding claim wherein the said tubular opening(s) extend outwards from an outer surface of the said container.

5. A method as claimed in any preceding claim wherein a plurality of tubular openings are provided.

6. A method as claimed in Claim 5 wherein at least two of the said tubular openings are crimped simultaneously.

7. A method as claimed in Claim 6 wherein the said at least two tubular openings are crimped using a common crimping die.

8. A method as claimed in any preceding claim wherein interior diameter of the said tubular opening(s) is substantially in the range 1.0-0.3 mm.

9. A method as claimed in any preceding claim wherein the step of closing the said container with the said closure member includes the step of welding the closure member to the container.

10. A method as claimed in any preceding claim wherein the container is a substantially rigid metal container.

11. A method as claimed in any preceding claim wherein the container comprises a Ni-Cu alloy.

12. A method as claimed in any preceding claim further comprising providing a humidity control means within the said container.

13. A device for sealingly enclosing a space into which at least one optical fibre is fed, produced by the method according to any of the preceding claims.

14. A device according to claim 13, containing at least one optical component or circuit.

15. A kit of parts for forming a device according to Claims 13 and 14.

16. A method of sealingly enclosing a space into which at least one optical fibre is fed; the method comprising the steps of:

providing a container and a closure member for closing the container;

providing at least one optical fibre having a metallic sleeve surrounding a selected length of the said optical fibre;

feeding the said optical fibre(s) through (a) respective opening(s) in the container and/or the closure member so as to position the said sleeve(s) in the said opening(s); and

applying the said closure member and welding the said metallic sleeve(s) into the said opening(s) so as to seal the said opening(s) and enclosed space.

17. A method as claimed in Claim 16 including the step of welding the said container and the said closure member together.

18. A method as claimed in Claim 16 or Claim 17 wherein the said metallic sleeve is crimped on the outer surface of the said optical fibre.

19. A method as claimed in any of Claims 16 to 18 wherein the said opening(s) is/are defined between adjoining edges of the container and closure member.

20. A method as claimed in any one of Claims 16 to 19 wherein the step of welding the said metallic sleeve(s), the said container and the said closure member together comprises laser welding.

21. A method as claimed in Claim 20 further comprising the step of welding the metallic sleeve(s) to the said container and the said closure member with a respective pair of laser beams.

22. A method as claimed in Claim 20 or Claim 21 wherein the laser is a Nd:Yag laser.

23. A method as claimed in any one of Claims 16 to 22 wherein a plurality of openings are provided.

24. A method as claimed in Claim 23 wherein the said openings are defined by respective recesses in the adjoining edges of the said container and closure member.

25. A method as claimed in any one of Claims 16 to 24 wherein the container is a substantially rigid metal container.

26. A method as claimed in any one of Claims 16 to 25 wherein the container comprises a Ni-Cu alloy.

27. A method as claimed in any one of Claims 16 to 26 further comprising providing a humidity control means within the said container.

28. A device for sealingly enclosing a space into which at least one optical fibre is fed,

produced by the method according to any one of Claims 16 to 27.

29. A device according to Claim 27, containing at least one optical component or circuit.

30. A kit of parts for forming a device according to Claims 28 and 29.

31. An enclosure of substantially moisture-proof material, preferably metal, sealingly enclosing at least one optical component and portions of at least one optical fibre leading from the said component through a sleeve-like member of substantially moisture-proof material, preferably metal, incorporated in the enclosure to the exterior of the enclosure for optical connection of the said component to other optical components outside the enclosure.

32. An enclosure as claimed in Claim 31, which enclosure is of a size and shape for fitting into an optical fibre organiser tray.

33. A fibre optic organiser tray having an enclosure according to Claim 31 or Claim 32 fitted therein.

Fig.1a.

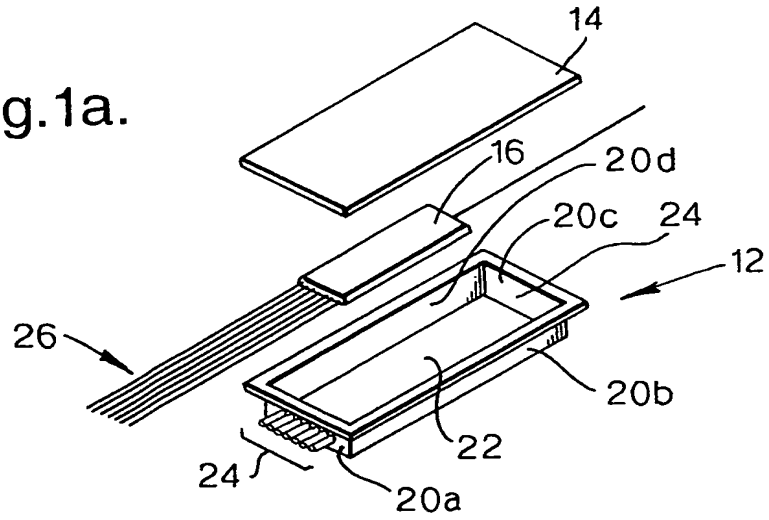


Fig.1b.

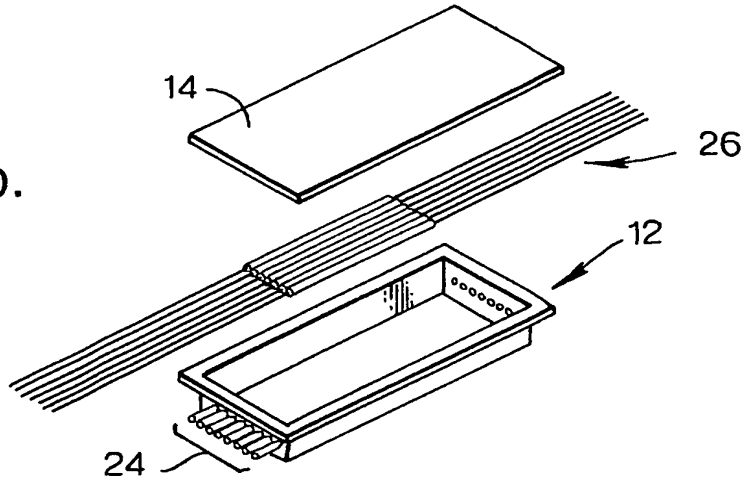


Fig.1c.

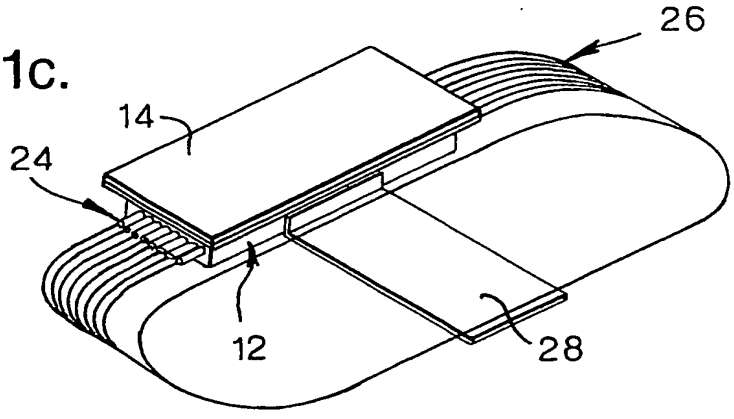


Fig.2.

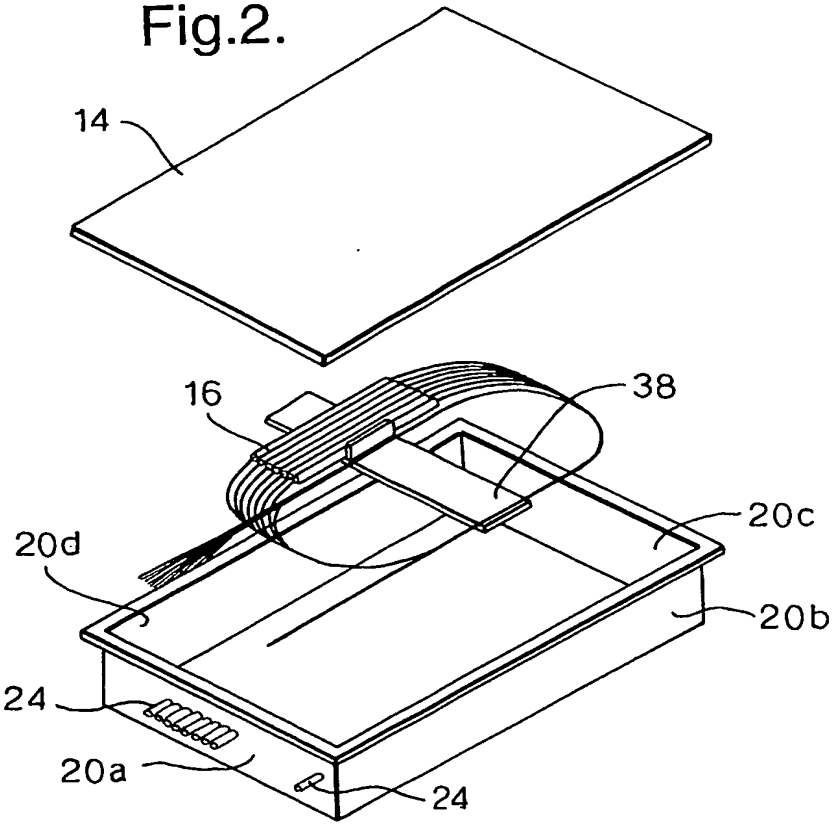


Fig.3.

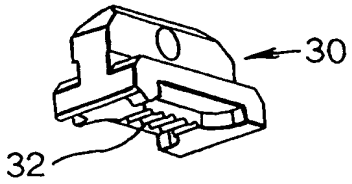


Fig.4.

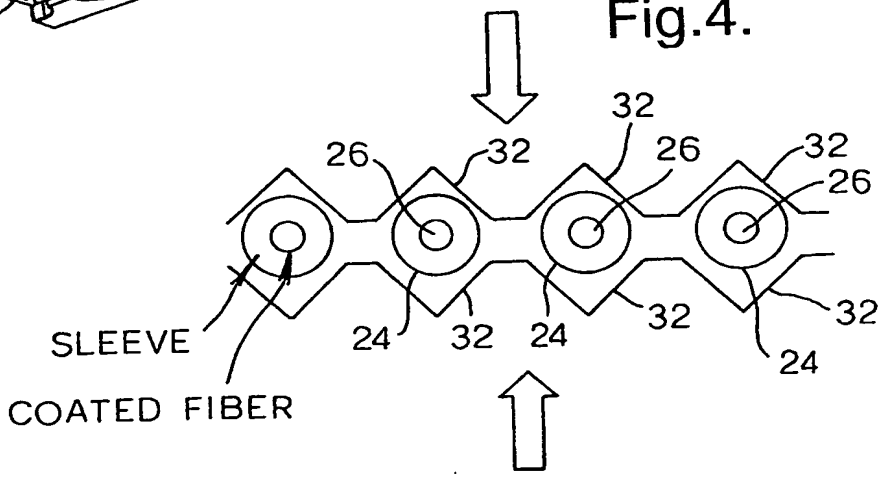
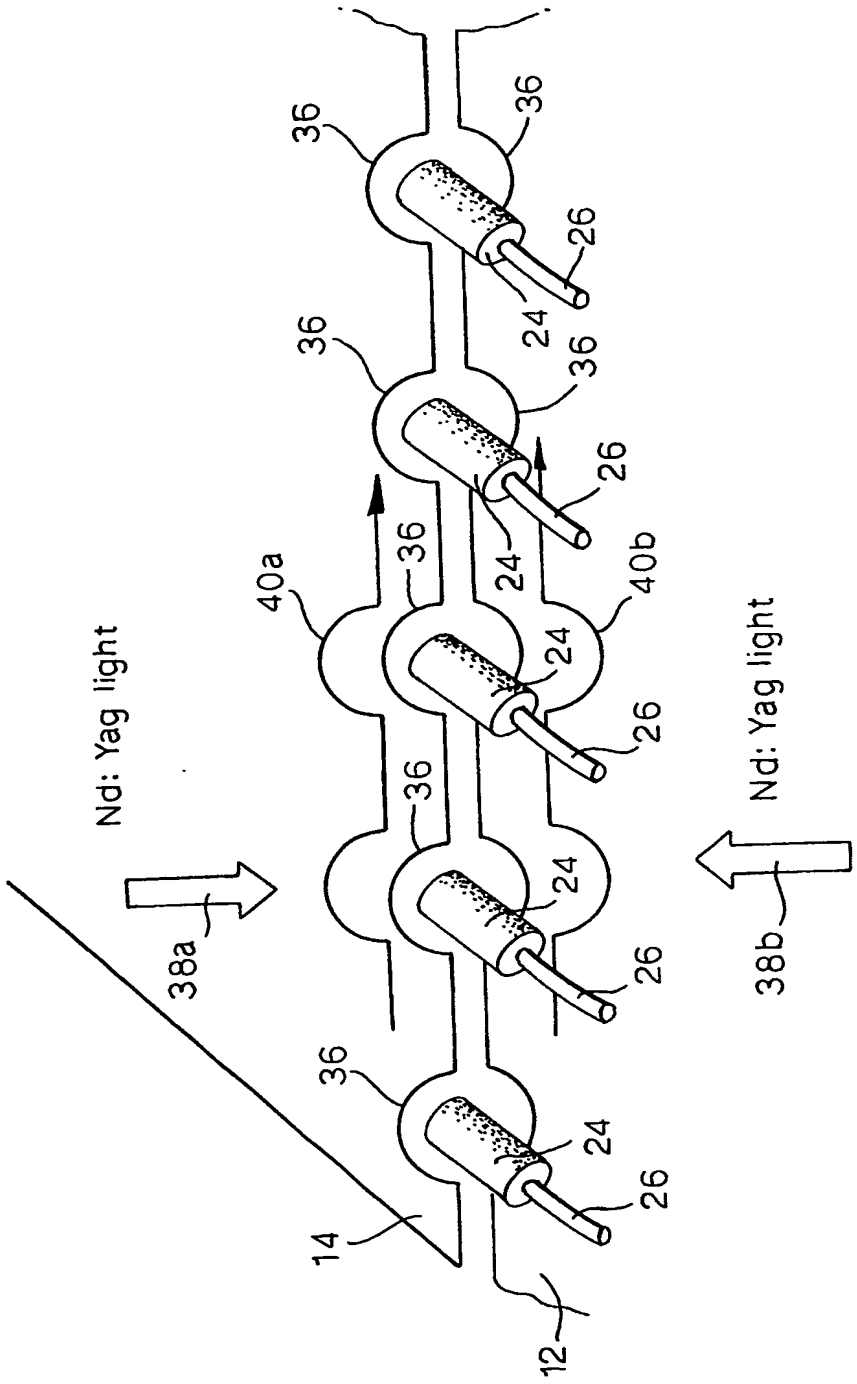


Fig.5.



INTERNATIONAL SEARCH REPORT

Interna Application No
PCT/GB 03/01958

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G02B6/42

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 00 21130 A (HONEYWELL INC) 13 April 2000 (2000-04-13)	1,13,15
X	page 1, line 31 -page 2, line 10 figures 1,2 abstract	16,31
A	US 5 278 358 A (BLONDIN JEAN-FRANCOIS) 11 January 1994 (1994-01-11)	1,13,15
X	abstract	16,31

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 August 2003	29/08/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Luck, W

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Internati Application No
PCT/GB 03/01958

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0021130 A	13-04-2000	US 2002005574 A1	17-01-2002
		CA 2346361 A1	13-04-2000
		EP 1118117 A1	25-07-2001
		WO 0021130 A1	13-04-2000
US 5278358 A	11-01-1994	FR 2676316 A1	13-11-1992
		AU 1525992 A	12-11-1992
		DE 69203282 D1	10-08-1995
		DE 69203282 T2	02-11-1995
		DK 512486 T3	27-11-1995
		EP 0512486 A1	11-11-1992
		ES 2074302 T3	01-09-1995
		GR 3017080 T3	30-11-1995